June 1993

Chemistry 30

Grade 12 Diploma Examination

Alberta
EDUCATION

June 1993

Chemistry 30

Grade 12 Diploma Examination

Description

Time allotted: 2.5 h
Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

Part A
has 42 multiple-choice questions each with a value of one mark.

Part B
has 7 numerical-response questions each with a value of one mark.

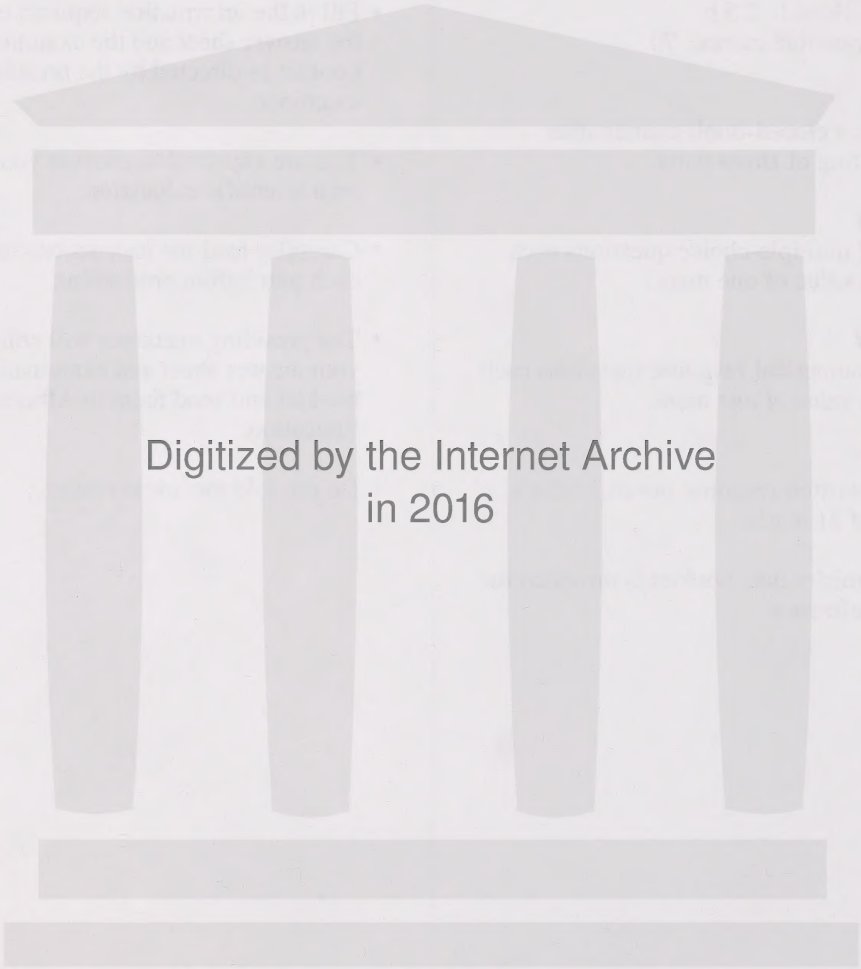
Part C
has 3 written-response questions for a total of 21 marks.

A chemistry data booklet is provided for your reference.

Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Carefully read the instructions for each part before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Do not fold the answer sheet.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*



Part A: Multiple Choice *(42 Questions)*

Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully and decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This diploma examination is for the subject of

A. biology
B. physics
C. chemistry
D. mathematics

Answer Sheet

Ⓐ Ⓑ ● Ⓓ

- **Use an HB pencil only.**
- If you wish to change an answer, erase **all** traces of your first answer.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Do not turn the page to start the examination until told to do so by the presiding examiner.

1. In a refrigerator, water is cooled from 36.0°C to −10.0°C. The water undergoes a change in

   A. kinetic energy only
   B. potential energy only
   C. translational energy only
   D. both kinetic and potential energy

2. The standard heat of formation for one mole of liquid water is

   A. +4.19 J/g•°C
   B. +6.03 kJ/mol
   C. +40.8 kJ/mol
   D. −285.8 kJ/mol

Use the following information to answer question 3.

Molar Heat of Formation (kJ/mol) of Halides

$AgCl_{(s)}$	−127.1	$NaCl_{(s)}$	−411.2
$AgBr_{(s)}$	−100.4	$NaBr_{(s)}$	−361.1
$AgI_{(s)}$	−61.8	$NaI_{(s)}$	−287.8

3. A generalization that could be made about these compounds is that

   A. iodine forms stronger bonds than chlorine
   B. iodine compounds are more stable than chlorine compounds
   C. sodium forms stronger bonds with halogens than silver
   D. silver halides are more stable than sodium halides

4. Which of these reactions is exothermic?

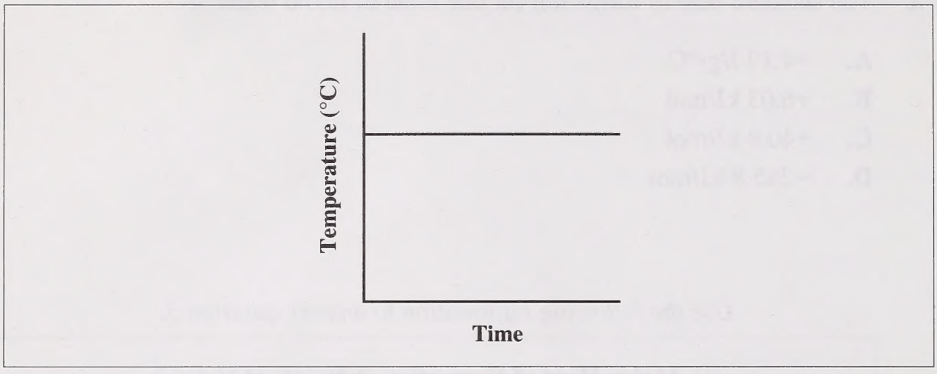
A. $N_2O_{(g)} + H_{2(g)} \longrightarrow N_{2(g)} + H_2O_{(l)} + 367.4\ kJ$

B. $\frac{1}{2} N_{2(g)} + O_{2(g)} \longrightarrow NO_{2(g)} \quad \Delta H = +33.2\ kJ$

C. $C_2H_{4(g)} + H_{2(g)} + 137.0\ kJ \longrightarrow C_2H_{6(g)}$

D. $\frac{1}{2} H_{2(g)} + \frac{1}{2} I_{2(s)} + 26.5\ kJ \longrightarrow HI_{(g)}$

Use the following graph to answer question 5.



5. One process that could be represented by this graph is

A. $CH_3OH_{(l)} + \text{energy} \longrightarrow C_{(s)} + 2\,H_{2(g)} + \frac{1}{2} O_{2(g)}$

B. $CH_3OH_{(l)} + \frac{3}{2} O_{2(g)} \longrightarrow CO_{2(g)} + 2\,H_2O_{(g)} + \text{energy}$

C. $CH_{4(g)} + \frac{1}{2} O_{2(g)} \longrightarrow CH_3OH_{(l)} + \text{energy}$

D. $CH_3OH_{(l)} + \text{energy} \longrightarrow CH_3OH_{(g)}$

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6. Which of these involves the greatest energy change?

A. $4\,U_{(s)} + 5\,O_{2(g)} \longrightarrow 2\,U_2O_{5(s)}$

B. $U_2O_{5(s)} \longrightarrow U_2O_{5(l)}$

C. ${}^{235}_{92}U \longrightarrow {}^{233}_{90}Th + 2\,{}^{1}_{1}H$

D. $PbO_{2(s)} \longrightarrow Pb_{(s)} + O_{2(g)}$

7. From a table of heats of formation, the heat of reaction is calculated by

A. subtracting the sum of the heats of formation of the reactant species from the sum of the heats of formation of the product species

B. subtracting the sum of the heats of formation of the product species from the sum of the heats of formation of the reactant species

C. multiplying the sum of the heats of formation of the reactant species by the sum of the heats of formation of the product species

D. adding the heats of formation of the reactant and product species

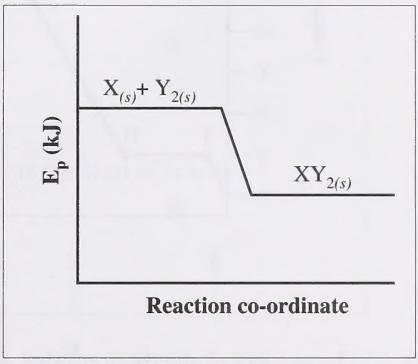
8. The statement that best explains the data represented in the diagram at the right is that ΔH is

A. positive and the reaction is exothermic

B. negative and the reaction is exothermic

C. negative and the reaction is endothermic

D. positive and the reaction is endothermic



9. The heat of reaction for $CuO_{(s)} + CO_{(g)} \longrightarrow Cu_{(s)} + CO_{2(g)}$ is

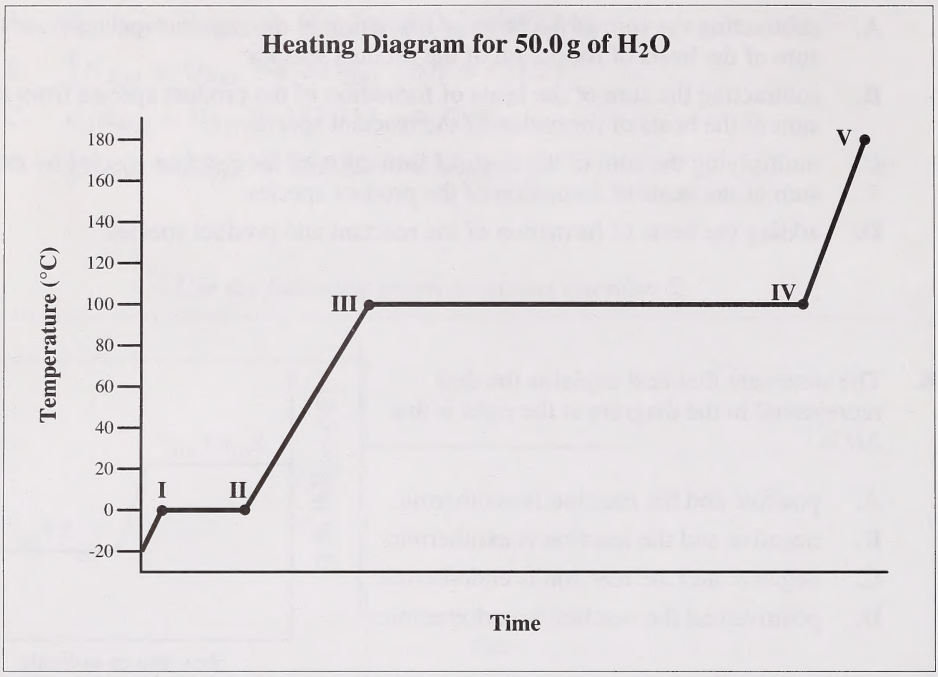
A. −661.3 kJ

B. −125.7 kJ

C. −440.3 kJ

D. +661.3 kJ

Use the following diagram to answer questions 10 and 11.



10. The section of the diagram that represents the largest increase in potential energy for the water is

A. I to II
B. II to III
C. III to IV
D. IV to V

11. The energy change for 50.0 g of water represented by section I to II on the diagram is

A. 6.03 kJ
B. 16.7 kJ
C. 40.8 kJ
D. 113 kJ

Use the following information to answer question 12.

$O_{2(g)} \longrightarrow 2O_{(g)}$	$\Delta H = +498$ kJ
$3O_{2(g)} \longrightarrow 2O_{3(g)}$	$\Delta H = +284$ kJ

12. The heat of reaction for $O_{3(g)} \longrightarrow 3O_{(g)}$ is

A. +214 kJ
B. +356 kJ
C. +463 kJ
D. +605 kJ

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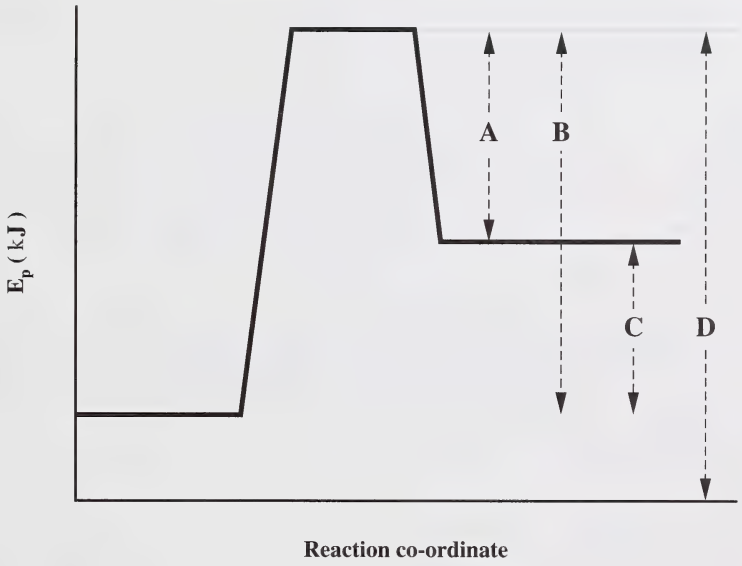
13. On the following diagram, which letter represents the heat of reaction?



14. The amount of heat energy that a refrigerator must remove from 400 g of water at 0.00°C to produce ice cubes at 0.00°C is

A. 134 kJ
B. 804 kJ
C. 2.41×10^3 kJ
D. 1.68×10^3 kJ

15. An acid will

A. donate protons during a chemical reaction
B. accept protons during a chemical reaction
C. increase the $[OH^-_{(aq)}]$ of water
D. increase the pH of water

16. An unidentified aqueous solution is a strong electrolyte that causes red litmus to turn blue. This solution could be

A. $HCl_{(aq)}$
B. $KOH_{(aq)}$
C. $NaCl_{(aq)}$
D. $CH_3OH_{(aq)}$

17. If chemically equivalent amounts of $HCl_{(aq)}$ and $NaOH_{(aq)}$ are mixed, the resulting solution will still

A. feel slippery
B. turn red litmus blue
C. taste sour
D. conduct electricity

18. A student mixed 100.0 mL of 0.50 mol/L acid samples with 100.0 mL of 0.50 mol/L base samples and measured the heat released by each mixture. The results are tabulated below:

	Heat Released
$HCl_{(aq)} + NaOH_{(aq)}$	50 kJ/mol
$HNO_{3(aq)} + KOH_{(aq)}$	49 kJ/mol
$HBr_{(aq)} + NaOH_{(aq)}$	52 kJ/mol
$HCl_{(aq)} + KOH_{(aq)}$	49 kJ/mol
$HNO_{3(aq)} + NaOH_{(aq)}$	51 kJ/mol

The heats of reaction are all nearly the same because

A. each acid is monoprotic

B. these acids and bases are all soluble electrolytes

C. the same net ionic reaction occurs in each case

D. solutions of $NaOH_{(aq)}$ and $KOH_{(aq)}$ of equal concentration have the same $[OH^-_{(aq)}]$

19. "A substance that increases the hydrogen ion concentration" is the

A. Arrhenius definition of an acid

B. Brønsted-Lowry definition of an acid

C. operational definition of an acid

D. Lewis definition of an acid

20. In the chemical equilibrium $H_2CO_{3(aq)} + SO_4^{2-}{}_{(aq)} \rightleftharpoons HCO_3^-{}_{(aq)} + HSO_4^-{}_{(aq)}$, which species has the greatest tendency to donate a proton?

A. $SO_4^{2-}{}_{(aq)}$

B. $HSO_4^-{}_{(aq)}$

C. $HCO_3^-{}_{(aq)}$

D. $H_2CO_{3(aq)}$

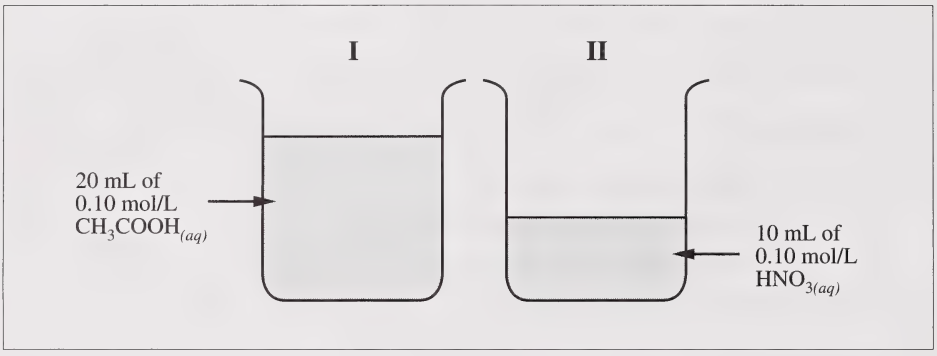
Use the following information to answer question 21.

$$HCO_3^-{}_{(aq)} + NO_2^-{}_{(aq)} \rightleftharpoons CO_3^{2-}{}_{(aq)} + HNO_{2(aq)}$$

21. The bases in this reaction are

A. $NO_2^-{}_{(aq)}$ and $CO_3^{2-}{}_{(aq)}$
B. $NO_2^-{}_{(aq)}$ and $HNO_{2(aq)}$
C. $HCO_3^-{}_{(aq)}$ and $HNO_{2(aq)}$
D. $HCO_3^-{}_{(aq)}$ and $NO_2^-{}_{(aq)}$

Use the following diagram to answer question 22.



22. The $[H_3O^+{}_{(aq)}]$ in the two solutions

A. is the same and is less than 1.0×10^{-7} mol/L
B. is greater in I than in II
C. is greater in II than in I
D. is the same and is greater than 1.0×10^{-7} mol/L

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23. In which reaction would the reactants be the favored species?

A. $H_2CO_{3(aq)} + OH^-{}_{(aq)} \rightleftharpoons H_2O_{(aq)} + HCO_3^-{}_{(aq)}$
B. $HSO_3^-{}_{(aq)} + PO_4^{3-}{}_{(aq)} \rightleftharpoons HPO_4^{2-}{}_{(aq)} + SO_3^{2-}{}_{(aq)}$
C. $H_3O^+{}_{(aq)} + CH_3COO^-{}_{(aq)} \rightleftharpoons CH_3COOH_{(aq)} + H_2O_{(l)}$
D. $H_2S_{(aq)} + OOCCOO^{2-}{}_{(aq)} \rightleftharpoons HOOCCOO^-{}_{(aq)} + HS^-{}_{(aq)}$

24. Plants are referred to as being either "acid-loving" or "base-loving." A "base-loving" plant would want to be watered with a solution that was

A. high in pH and low in $[OH^-_{(aq)}]$

B. high in pH and high in $[H_3O^+_{(aq)}]$

C. high in pH and low in $[H_3O^+_{(aq)}]$

D. low in pH and high in $[OH^-_{(aq)}]$

25. A student poured a solution into four test tubes and recorded these observations after the indicators were added:

Test tube	Indicator	Solution color
1	methyl orange	yellow
2	methyl red	yellow
3	bromothymol blue	yellow
4	phenol red	yellow

What is the approximate pH of the solution?

A. 4.4

B. 6.0

C. 7.6

D. 8.0

Use the following information to answer question 26.

Statement 1	Statement 2
In the reaction $NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$, $NH_{3(aq)}$ acts as a base.	$NH_{3(aq)}$ accepts a proton from $H_2O_{(l)}$.

26. Given this information, it is correct to say that

A. both statements are true, and statement 2 is a correct explanation for statement 1

B. both statements are true, but statement 2 does not explain statement 1

C. statement 1 is true and statement 2 is false

D. statement 1 is false and statement 2 is true

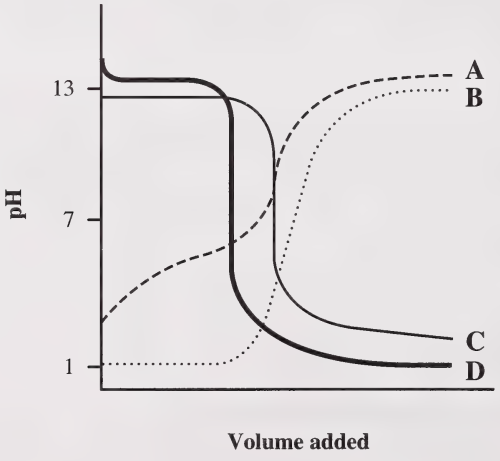
27. A hydrochloric acid solution is standardized using pure sodium carbonate as the primary standard. If 30.0 mL of the acid are required to react completely with a 0.50 g sample of $Na_2CO_{3(s)}$, what is the pH of the $HCl_{(aq)}$?

A. 2.02
B. 1.10
C. 0.80
D. 0.50

28. An unlabelled beaker contains a blue solution that is known to be either $CuSO_{4(aq)}$ or bromothymol blue. Any one of several substances could be added to this solution in order to identify it. Which of these reagents would **not** be useful in determining the contents of the beaker?

A. $Ag_{(s)}$
B. $Pb_{(s)}$
C. $NaOH_{(aq)}$
D. $HCl_{(aq)}$

29. A student did four acid-base titrations and plotted them on the same graph. Which of the four curves best represents the neutralization of a weak acid by a strong base?



30. In the half-reaction $Al^{3+}_{(aq)} + 3e^- \longrightarrow Al_{(s)}$, the aluminum ions are undergoing

A. oxidation
B. neutralization
C. electrolysis
D. reduction

31. "An electron and his two brothers are on the beach in Hawaii talking about how they have run away from the bad weather at home." The "home" they have just left is

A. a reducing agent that has been oxidized
B. a reducing agent that has been reduced
C. an oxidizing agent that has been oxidized
D. an oxidizing agent that has been reduced

32. For the reaction $Fe_{(s)} + Sn^{4+}_{(aq)} \longrightarrow Sn^{2+}_{(aq)} + Fe^{2+}_{(aq)}$, a true statement is

A. $Sn^{4+}_{(aq)}$ causes $Fe_{(s)}$ to be reduced
B. $Fe_{(s)}$ causes $Sn^{4+}_{(aq)}$ to be reduced
C. $Sn^{2+}_{(aq)}$ is the oxidizing agent
D. $Fe_{(s)}$ is the oxidizing agent

33. When hydrogen cyanide is burned,
$4\,HCN_{(g)} + 9O_{2(g)} \longrightarrow 4\,CO_{2(g)} + 2\,H_2O_{(g)} + 4\,NO_{2(g)}$,
which atom does **not** change its oxidation state?

A. hydrogen
B. carbon
C. oxygen
D. nitrogen

Use the following unbalanced equation to answer question 34.

$$KBr_{(aq)} + H_2SO_{4(aq)} + MnO_{2(s)} \rightarrow KHSO_{4(aq)} + MnSO_{4(aq)} + H_2O_{(l)} + Br_{2(l)}$$

34. The balanced net ionic redox equation for this reaction is

A. $2Br^-_{(aq)} + MnO_{2(s)} \rightarrow Mn^{2+}_{(aq)} + Br_{2(l)} + 4e^-$

B. $2Br^-_{(aq)} + 4H^+_{(aq)} + MnO_{2(s)} \rightarrow Mn^{2+}_{(aq)} + 2H_2O_{(l)} + Br_{2(l)}$

C. $2KBr_{(aq)} + H_2SO_{4(aq)} + MnO_{2(s)} \rightarrow 2KHSO_{4(aq)} + MnSO_{4(aq)} + H_2O_{(l)} + Br_{2(l)}$

D. $2K^+_{(aq)} + 2Br^-_{(aq)} + H^+_{(aq)} + Mn^{4+}_{(aq)} + 4e^- \rightarrow Mn^{2+}_{(aq)} + 2H_2O_{(l)} + Br_{2(l)}$

Use the following information to answer question 35.

$$3MnO_4^-{}_{(aq)} + 24H^+_{(aq)} + 5Fe_{(s)} \rightarrow 3Mn^{2+}_{(aq)} + 12H_2O_{(l)} + 5Fe^{3+}_{(aq)}$$

35. All the following methods could be used to calculate the number of moles of $Fe_{(s)}$ **except** for

A. moles of $MnO_4^-{}_{(aq)} \times \frac{5}{3}$

B. moles of $H^+_{(aq)} \times \frac{5}{24}$

C. moles of $H_2O_{(l)} \times \frac{5}{12}$

D. moles of $Mn^{2+}_{(aq)} \times \frac{3}{5}$

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36. If the reduction of iodine had been selected as the standard half-reaction, then the E° value for the reduction of $PbSO_{4(s)}$ would be

A. −0.90 V

B. −0.18 V

C. +0.18 V

D. +0.90 V

37. The standard electrode potential for the conversion of $Sn^{4+}_{(aq)}$ to $Sn^{2+}_{(aq)}$ is

A. +0.15 V
B. −0.15 V
C. +0.14 V
D. −0.14 V

38. Jody wishes to prepare 100 mL of a 0.010 mol/L $SnF_{2(aq)}$ to titrate with freshly acidified $KMnO_{4(aq)}$ of uncertain concentration. The equipment available to Jody includes a 100 mL volumetric flask, a 10 mL pipette, a balance with a precision of ± 0.01 g, and a 150 mL beaker.

Once Jody obtains the appropriate mass of $SnF_{2(s)}$, which procedure should she use to prepare this solution?

A. Place the $SnF_{2(s)}$ in the beaker and add exactly 100 mL of water from the volumetric flask.
B. Place the $SnF_{2(s)}$ in the beaker and add exactly 100 mL of water from the pipette in 10 mL portions.
C. Place the $SnF_{2(s)}$ in the volumetric flask, dissolve it in less than 100 mL of water, and then dilute to the 100 mL mark.
D. Place the $SnF_{2(s)}$ in the beaker, dissolve it in more than 100 mL of water, and then pour the solution into the volumetric flask to the 100 mL mark.

39. Given the following spontaneous reactions,

$$X^{2+}_{(aq)} + Y_{(s)} \longrightarrow X_{(s)} + Y^{2+}_{(aq)}$$
$$X^{2+}_{(aq)} + Q_{(s)} \longrightarrow X_{(s)} + Q^{2+}_{(aq)}$$
$$Y^{2+}_{(aq)} + Z_{(s)} \longrightarrow Y_{(s)} + Z^{2+}_{(aq)}$$
$$Z^{2+}_{(aq)} + Q_{(s)} \longrightarrow Z_{(s)} + Q^{2+}_{(aq)}$$

the strongest oxidizing agent is

A. $Q^{2+}_{(aq)}$
B. $Y^{2+}_{(aq)}$
C. $Z^{2+}_{(aq)}$
D. $X^{2+}_{(aq)}$

40. Given the reaction
$3NO_3^-{}_{(aq)} + 6H^+{}_{(aq)} + X_{(s)} \longrightarrow 3NO_{2(g)} + 3H_2O_{(l)} + X^{3+}{}_{(aq)}$
$E^\circ_{net} = +2.18$ V, the electrode potential for the half-reaction
$X^{3+}{}_{(aq)} + 3e^- \longrightarrow X_{(s)}$ is

A. −3.00 V
B. −2.19 V
C. −1.38 V
D. −1.23 V

41. Where does reduction occur in an electrolytic cell?

A. In a salt bridge
B. At the cathode
C. At the anode
D. In a porous cup

42. What mass of aluminum is deposited during the electrolysis of molten aluminum bromide if 30.0 A flow through the cell for 4.85 h?

A. 146 g
B. 48.8 g
C. 1.46 g
D. 0.0351 g

You have now completed Part A. Proceed directly to Part B.

Part B: Numerical Response *(7 Questions)*

Instructions

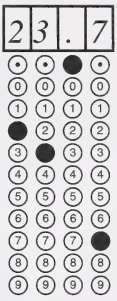
- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**
- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

Sample Calculation Question and Solution

The mass in grams of silver produced when 0.220 mol of silver nitrate reacts with excess copper is _____g.
(Record your answer to three digits.)

$$\begin{aligned} \text{mass}_{Ag} &= 0.220 \text{ mol} \times 107.87 \text{ g/mol} \\ &= 23.7314 \text{ g} \\ &= 23.7 \text{ g (rounded to three digits)} \end{aligned}$$

Record 23.7 on the answer sheet →



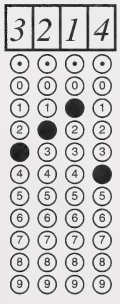
Sample Correct-order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____.
(Record all four digits.)

1. mathematics
2. chemistry
3. biology
4. physics

Answer 3, 2, 1, 4

Record 3214 on the answer sheet →



Start Part B immediately.

1. In a recycling plant, the amount of heat needed to raise the temperature of 84.6 kg of aluminum from room temperature (25.0°C) to its melting point is _____ MJ.
(Record your answer to three digits.)

2. A sample of solid cesium initially at 28°C is continuously heated. The energy changes that may occur are indicated below:

1. The solid warms and thus gains kinetic energy.
2. The liquid warms and thus gains potential energy.
3. The solid melts and thus gains potential energy.
4. The solid melts and thus gains kinetic energy.
5. The liquid warms and thus gains kinetic energy.
6. The liquid vaporizes and thus gains kinetic energy.
7. The liquid vaporizes and thus gains potential energy.
8. The gas warms and thus gains potential energy.
9. The gas warms and thus gains kinetic energy.

The first four energy changes that would occur, in order, are _____ .
(Record all four digits.)

3. A 0.200 mol/L solution of an acid has a pH of 1.831. The per cent dissociation of the acid is _____%. (Record your answer to three digits.)

4. Assuming complete dissociation, what is the pH of the solution formed when 50.0 mL of 0.01 mol/L $Ba(OH)_{2(aq)}$ are mixed with 50.0 mL of 0.01 mol/L $NaOH_{(aq)}$? (Record your answer to three digits.)

Use the following information to answer question 5.

$$2PbO_{2(s)} + Sn_{(s)} \longrightarrow SnO_{2(s)} + 2PbO_{(s)} + 463.9\ kJ$$

5. The heat released when 0.100 mol of oxidizing agent reacts is _____ kJ. (Record your answer to three digits.)

6. Given the following half-cells listed at the right, which pair will produce an electrochemical cell with an $E°_{net} = 2.00$ V?

- The cathode reagents are _____. (Record in first column)
- The anode reagents are _____. (Record in second column)

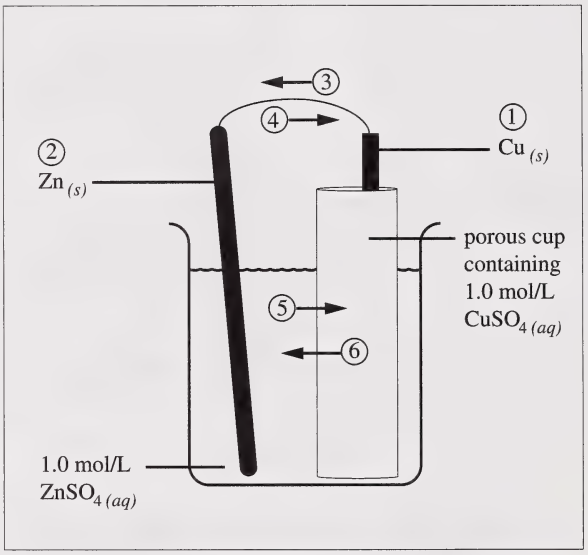
1. $Cu_{(s)}$ with $Cu^{2+}_{(aq)}$
2. $Fe_{(s)}$ with $Fe^{2+}_{(aq)}$
3. $Al_{(s)}$ with $Al^{3+}_{(aq)}$
4. $Mg_{(s)}$ with $Mg^{2+}_{(aq)}$

LEAVE THE THIRD AND FOURTH COLUMNS BLANK

RECORD YOUR ANSWER ON THE ANSWER SHEET

7. In the electrochemical cell shown at the right,

- the anode is _____ (Record in first column)
- the cathode is _____ (Record in second column)
- the direction of electron flow is _____ (Record in third column)
- the direction of anion movement is _____ (Record in fourth column)



RECORD YOUR ANSWER ON THE ANSWER SHEET

You have now completed Part B. Proceed directly to Part C.

Part C: Written Response *(3 Questions)*

Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers **must show all** pertinent explanations, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences for a written response, and correct units and significant digits for a numerical response.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Start Part C immediately.

For Department Use Only

(7 marks)

1. Iron metal is easily oxidized to $Fe^{2+}_{(aq)}$ by an acidic dichromate solution.

a. Write the net ionic equation for this process and determine the mass of iron metal oxidized by 50.0 ml of 0.250 mol/L acidified $K_2Cr_2O_{7(aq)}$.

b. Oxidation of iron is often an undesirable redox reaction in the environment. There are several methods to prevent corrosion of iron. Describe one of these methods and explain in detail how this method prevents iron from corroding.

2. In an experiment designed to determine the temperature change of water when heated by three different metals, a 100 g chunk of each metal was heated to 300.0°C and then dropped into a Styrofoam™ calorimeter containing 250 mL of water initially at 25.0°C. The final temperature of the systems were recorded as follows:

aluminum + water system	$t_f = 46.7°C$
copper + water system	$t_f = 34.6°C$
iron + water system	$t_f = ?$

a. Determine the final temperature of the iron + water system.

b. Explain why these three metals cause different changes in the temperature of water.

c. Which of these three metals, when made into a cooking pot, will keep water warm the longest when the pot is removed from the stove? Why?
(Assume that the mass of each pot, the initial temperature of the water, the amount of water, and the rate of heat loss to the surroundings are the same for all three metals.)

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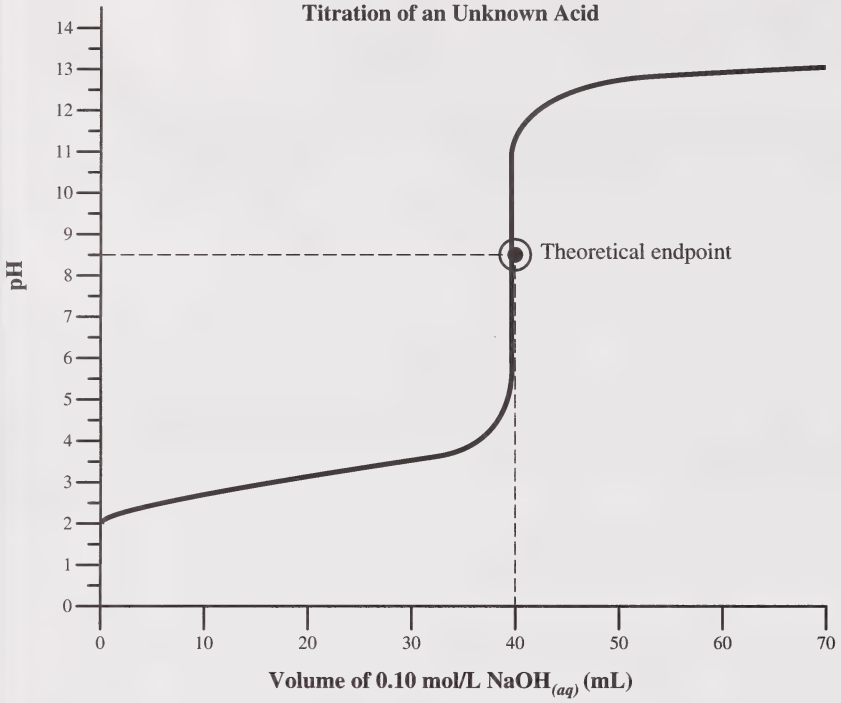
(7 marks)

3. A 50.0 mL sample of an acid was titrated by a solution of 0.10 mol/L $NaOH_{(aq)}$ and the following titration curve was plotted:



List **four** characteristics that either describe this acid or the solution it forms. Support each characteristic with a calculation or an explanation based on information given in this graph.

Continue your answer on page 23, if required.

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You have now completed the examination.
If you have time, you may wish to check your answers.

No marks will be given for work done on this page.

Fold and tear along perforation.

No marks will be given for work done on this page.

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Chemistry 30

June 1993

Name

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Chemistry 30

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M3

M4